DOCUMENT RESUME

ED 430 806 SE 062 592

AUTHOR	Thomas, John P.
TITLE	Influences on Mathematics Learning among African American High School Students.
PUB DATE	1999-00-00
NOTE	39p.
PUB TYPE	Reports - Research (143)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Black Students; Cultural Differences; Cultural Influences; Educational Attitudes; Ethnic Groups; *Ethnicity; Family School Relationship; *High School Students; High Schools; Higher Education; Learning Strategies; *Mathematics Achievement; Mathematics Education
IDENTIFIERS	*African Americans

ABSTRACT

The major purpose of this study was to determine if the influences of educational productivity factors on achievement and attitudes are the same for African Americans and other ethnic groups. Using Walberg's Educational Productivity Model as a framework, this study estimated the influence of home environment, quality and quantity of instruction, use of out-of-school time, peers, perceptions about the usefulness of mathematics in the future, and school socio-economic status on mathematical achievement and attitude outcomes for students of various ethnic backgrounds. Transcript and survey data representing the factors were collected from 10,001 students who participated in all of the first three waves of the National Longitudinal Study of 1988 (NELS:88). Regression analyses indicated that the relationship between educational productivity factors with both mathematics achievement and attitudes were no different for African Americans than for members of other ethnic groups. In addition, the analyses indicated that even though there were differences in mathematics achievement between African Americans and other ethnic groups, they were substantially diminished when differences in productivity factors with respect to ethnicity were controlled. (Author)

Running head: AFRICAN AMERICAN LEARNING

Influences on Mathematics Learning Among African American High School Students

John P. Thomas

College of Lake County, Illinois

Influences on Mathematics Learning Among African American High School Students

Abstract

The major purpose of this study was to determine if the influences of educational productivity factors on achievement and attitudes are the same for African Americans and other ethnic groups. Using Walberg's Educational Productivity Model as a framework, this study estimated the influence of home environment, quality and quantity of instruction, use of out-of-school time, peers, perceptions about the usefulness of mathematics in the future, and school socio-economic status on mathematics achievement and attitude outcomes for students of various ethnic backgrounds. Transcript and survey data representing the factors were collected from 10,001 students who participated in all of the first three waves of the National Longitudinal Study of 1988 (NELS:88). Regression analyses indicated that the relationship between educational productivity factors with both mathematics achievement and attitudes were no different for African Americans than for members of the other ethnic groups. In addition, the analyses indicated that even though there were differences in mathematics achievement between African Americans and other ethnic groups, they were substantially diminished when differences in productivity factors with respect to ethnicity were controlled.

Influences on Mathematics Learning

Among African American High School Students

Although recent studies have indicated that the gap in achievement test scores among ethnic groups has appreciably narrowed over the years (e.g., Cross, 1995; Gross, 1993, Jones, 1985), many of these studies revealed that Asian/Pacific Islander and White students continue to substantially out-perform students from under-represented ethnic minority groups (particularly African Americans) on tests of mathematics achievement. Moreover, while some ethnic minority groups (e.g, Hispanics and Native Americans) have made substantial gains on mathematics achievement tests in recent years, African Americans have exhibited the least amount of improvement among the major ethnic and language minority groups in the United States (see Cross, 1995)[1].

The substantial disparities in mathematics and science achievement between Asian/Pacific Islanders and Whites and under-represented minority groups have raised serious concerns among educators and policy makers. First, from a national perspective, deficiencies in the education of any ethnic minority group in mathematics and science would subsequently impact the quality and quantity of human resources in the United States. The rationale for this concern comes from the fact that many ethnic minority populations, such as African Americans and Hispanics, have been growing at a much faster rate than other ethnic groups. The Bureau of the Census reported that by the year 2005, 30 percent of the U.S. population will be ethnic minorities and by 2050, the ethnic minority population will be up to 50 percent (Peng and others, 1995). Some authors have posited that failure to improve the education of any ethnic group in science and mathematics could seriously jeopardize the availability of human resources and subsequently hamper the

economic advancement and competitiveness of the United States (Bailey, 1990). According to a report by the U.S. Department of Labor (1988), between 1986 and 2000, 21 million new jobs will be created in the U.S., and many of these new jobs will require basic skills in mathematics and the ability to reason. Furthermore, more than half of these new jobs will require some education beyond high school and almost one-third will require a college education (Anderson, 1990). As under-represented ethnic minority populations are expected to increase greatly through the year 2000, it is important to encourage students belonging to these groups to focus on academic areas (i.e., mathematics and science) that those jobs will demand (Anderson, 1990).

Secondly, ethnic minority populations that have a poor understanding of mathematics and science face possible economic disadvantages in an increasingly technologically oriented society and labor market (Bailey, 1990; Peng and others, 1995). Peng and others (1995) reported that, among the high school class of 1982 who did not attend college, the unemployment rate for students with science and mathematics test scores below the national average was higher than those with scores at or above the national average. Additionally, among the graduates who were employed at any point twenty months after graduation, a majority of those whose science and mathematics scores were below the national average were employed in low-skilled occupations (e.g., clerks, operative workers, laborers, or service workers) [Peng and others, 1995]. The majority of these students were ethnic minorities (Peng and others, 1995).

Studies have also found that high school graduates with low achievement in mathematics, who continued their education after high school, were less likely than other students to be in mathematics and science-oriented fields in college (Peng, Fetters, and Kolstad, 1981). Many authors have suggested that this may explain the substantial under representation of African

Americans, Hispanics, and Native Americans in mathematics and science related fields (Anderson, 1990; Peng and others, 1995). For example, data from the National Center for Education Statistics (1993) indicated that even though African Americans and Hispanics comprised more than 10 percent of the American population, only 3.7 percent of the total Bachelor's degree recipients in engineering in 1990-91 were African American, and 3.3 percent were Hispanic. The percentages of Master's and Doctoral degrees in mathematics and science-related disciplines conferred upon African Americans and Hispanics were substantially lower (National Center for Education Statistics, 1993).

Theoretical Framework

Some authors have suggested that while research has indicated that differences in mathematics achievement exist between Whites and Asian/Pacific Islanders, and African Americans, Hispanics, and Native Americans as early as first grade, precise indicators of how and why these discrepancies develop are unknown and still unexplained (Ferguson, 1990; Gross, 1993). However, many studies have indicated that learning mathematics, like student learning in general, is associated with multiple factors of family, school, and individual (Ibe, 1994; Peng and others, 1995; Reyes and Stanic, 1985).

Walberg's theoretical framework for the Educational Productivity Model is an augmentation of previous multi variate models, such as Caroll's (1963) Model of Academic Learning and Bloom's (1976) Model of Mastery Learning, (Walberg, 1984). The model encompasses nine factors, which, when optimized, increase affective, behavioral, and cognitive learning. The nine factors fall into three categories: student aptitude, instruction, and psychological environment. Student aptitude includes: (1) ability or prior achievement; (2)

development, and (3) motivation, or self-concept. Instruction encompasses: (4) the amount of time students engage in learning and (5) the quality of the instructional experience. The environmental factors include: (6) the home, (7) the classroom social group, (8) the peer group outside the school, and (9) use of out-of-school time.

The nine educational productivity factors have been found to affect each other in differing degrees and in turn to influence student learning (Ibe, 1994). Additionally, the factors in the educational productivity model have been determined to be potent, consistent, and generalizable since they are grounded upon a synthesis of over 3,000 studies of the variables that impact school learning (Walberg, 1984).

Statement of the Problem

It has been shown that a large part of the differences in achievement between ethnic groups can be accounted for by alterable factors associated with educational productivity (e.g., Ibe, 1994; Peng and Wright, 1994). Yet, few studies have examined the influence of all or most of the educational productivity factors on both attitudes and achievement according to ethnicity. Peng and Wright (1994) examined the kinds of home environments and educational activities experienced by Asian American students which account for differences in academic achievement between them and other ethnic groups. They found that home environment and educational activities as well as school type (e.g., private vs. public) accounted for 30 percent of the variance of student achievement for Asian Americans, Whites, African Americans, Hispanics, and Native Americans whereas only 3 percent of the variance could be attributed to ethnic differences (Peng and Wright, 1994). Their study, however, examined the strength of the association between only two of the educational productivity factors and academic achievement. Furthermore, their study

did not examine the relationship between the productivity factors and students' attitudes toward mathematics.

Using six of the nine educational productivity factors, Ibe (1994) estimated the influences of home environment, motivation, ability, classroom environment, quality of instruction, and instructional time on mathematics outcome. Ibe's (1994) study dealt not only with the effect of the aforementioned factors on students' mathematics achievement, but also the factors' impact on students' attitudes toward mathematics. He found that both eighth grade students' achievement and attitudes toward mathematics are related to selected educational productivity factors (Ibe, 1994).

Ibe's (1994) study, however, did not account for possible differences in achievement or attitude according to the ethnicity of the student. Yet, his research, as well as many others' (e.g., Fraser, Walberg, Welsh, and Hattie, 1987; Harnisch and Archer, 1986) indicated the importance of examining the effect of multiple factors on student achievement and attitudes toward mathematics using a proven model of educational productivity.

Peng and others (1995) examined the relationship between home, school, and student attitudinal variables and mathematics and science achievement for different ethnic groups. Their study revealed that differences in achievement were diminished when the productivity factors were held constant. But the study failed to explain the relationship between these variables and achievement outcomes among the five ethnic groups independently.

Recent research regarding the influence of socio-cultural factors on learning and achievement in mathematics for African Americans and other ethnic minority students (e.g., Anderson, 1990; Bailey, 1990; Lee and Slaughter-Defoe, 1995), and the nexus between the

educational productivity factors and learning outcomes for all students, highlights the need for analysis to determine whether the factors are differentially related to mathematics achievement and attitudes according to ethnicity.

The main purpose of the present study was to determine whether the strength of association of Walberg's educational productivity factors with mathematics achievement and attitudes regarding mathematics differed among African Americans and Asian/Pacific Islanders, Hispanics, Native Americans, and Whites. This is the first comprehensive study examining the influence of educational productivity factors, plus, attitudes regarding the usefulness of mathematics and social class across all major ethnic groups, through the utilization of a large, national data set.

Method

Participants

All of the participants in the present study were students who took part in the base year (1988), first follow-up (1990), and second follow-up waves of data collection for the National Education Longitudinal study of 1988 (NELS:88). The initial cohort for the NELS:88 study consisted of eighth grade students who were followed at two-year intervals as the group passed through high school into post-secondary education or into their careers.

For the base-year component of the NELS:88 study, a two-stage stratified probability sample was used to select a nationally representative sample of schools and students. For the first stage, schools constituted the primary sampling unit. A pool of 1,032 schools was selected through stratified sampling with probability of selection proportional to eighth-grade size and with over sampling of private schools. Of the 1,032 selected schools, 30 were considered ineligible. Of the 1,002 eligible schools, 698 participated. An additional 359 schools (supplied by alternative selections from a replacement pool) also participated, for a total sample of 1,057 cooperating schools, of which 1,052 schools (815 public schools and 237 private schools) contributed usable student data. In addition to the selection process described above, over sampling of schools with very large percentages of African American or Hispanic students or both was conducted based on information provided to the National Opinion Research Center (NORC), a subcontractor for the NELS:88 base year study, and by the Office of Civil Rights (OCR) and other sources (National Center for Education Statistics, 1994).

The second stage of the base-year selection process produced a random selection of 26,435 students among the sampled schools, resulting in participation by 24,323 eighth-grade

students (an average of 23 students per school). This sample included 15,692 White, 1,527 Asian/Pacific Islander, 3,171 Hispanic, 3,009 African American, and 924 Native American students. Of these, 20,062 students completed both student questionnaires and cognitive tests (National Center for Education Statistics, 1994). Of these, 10,001 students were included in the initial cohort for the present study. The percentage of participants by ethnicity in the initial cohort were as follows: African American: 18.8 percent; Asian/Pacific Islander: 11.1 percent; Hispanic: 23.2 percent; Native American: 6.6 percent; and White: 40.2 percent.

Instrument

The base-year study of the NELS:88 included a self-administered questionnaire for gathering information about background variables and a range of other topics including school work, aspirations, and social relationships (National Center for Education Statistics, 1994). The students also completed a series of cognitive tests developed by the Educational Testing Service (ETS). The cognitive test battery included a multiple choice mathematics test, which consisted of quantitative comparisons and other questions assessing mathematical knowledge. For the first and second-follow up studies, data collection instruments were similar in content and form to those utilized in the base-year study. As in the base-year study, the first and second follow-up studies included student questionnaires and cognitive tests. The student questionnaire asked students about such topics as academic achievement; student perceptions of their curriculum and school, family structure and environment; social relations; and aspirations, attitudes, and values, particularly as they relate to high school and occupational or post-secondary educational plans (National Center for Education Statistics, 1994).

<u>Procedure</u>

The major focus of the present study was to investigate whether the influences of the educational productivity factors on mathematics achievement outcome and attitudes toward mathematics were the same for African American students and students of other ethnic groups. In order to examine this issue, it was necessary to address the following questions: (1) Are there differences among African Americans, Asian/Pacific Islanders, Hispanics, Native Americans, and Whites in mathematics achievement and attitude outcomes?; (2) Are the educational productivity factors related to mathematics achievement and attitude outcomes?; and (3) Are there differences in mathematics achievement and attitude outcomes between African American students and students of other ethnic groups, once the differences in the productivity factors were controlled?

The independent variables used in the analyses included eight of the nine educational productivity factors. The productivity factors included in the present study were: home environment, prior mathematics achievement, motivation, quantity of instruction, quality of instruction, classroom environment, peer influences, and use of out-of-school time. The ninth productivity factor, age, was omitted because the students were all of the same grade level and nearly homogeneous with respect to age. To control statistically for possible extraneous variation, two additional variables were also included as predictor variables in the study. These variables were: school socio-economic status, and usefulness of mathematics in the future. The study also employed ethnic group self-identification of the student. The variables indicating television viewing time were not recoded for this scale. Thus higher values for this variable indicated more time spent watching television.

The dependent variables included students' mathematics achievement test scores, derived

from the cognitive test of mathematics ability administered during the first follow-up of NELS:88 (mathematics achievement outcome) and students' attitudes towards mathematics (mathematics attitude outcome), derived from one of two items from the second follow-up of NELS:88. One of the two items measuring students' attitudes was directed at those students enrolled in a mathematics course during the second follow-up of NELS:88. The second item was directed at those students not enrolled in a mathematics course during the second follow-up. In order to obtain a single outcome measure for attitude, response scores for the items were standardized (recoded to z-scores) and non-responses were recoded to zeros for each item independently. The standardized items were then added to obtain a single outcome measure for each student. Scores of zero from the composite measure were recoded to missing data so that students' not responding to either of the two items were not included in the analyses.

The indicators were selected from items from the base year and the first and second follow-up data files of the NELS:88. The indicators of the variables, their coding schemes, and frequencies are illustrated in Table 1.

Insert Table 1 here

Results

Descriptive Analyses

Reliabilities, using Cronbach's measure of internal consistency, were calculated for self concept ($\alpha = .86$), quality of instruction ($\alpha = .43$), peer influences ($\alpha = .79$), quantity of instruction ($\alpha = .43$), and television viewing time ($\alpha = .69$), as these variables were measured using multiple observed indicators. The low reliability for the scale measuring quantity of instruction was probably due to lack of students having had both geometry and algebra II by the end of their second year in high school. Both scales were used in the current study however since their indicators have been frequently cited in the research as measures of quantity and quality of instruction (see Peng and others, 1995).

A summary of descriptive information for mathematics achievement and attitude outcomes by ethnic group, including means, standard deviations, minima, maxima is illustrated in Table 2. It should be noted that in Table 2, mathematics attitude outcome was reported, not in composite form, but in its original form as two mutually exclusive items, namely: level of interest for students enrolled in mathematics during the second follow-up and for students not enrolled in mathematics. Bivariate correlations between the indicators of the independent variables and the outcome variables are summarized in Table 3.

Insert Tables 2 and 3 here

Main Analyses

The first analysis examined whether there were differences among the ethnic groups in

mathematics achievement and attitude outcomes. Using analysis of variance (ANOVA), the results indicated that both mathematics achievement and attitude outcomes differed according to ethnicity, $F(4, 8707) = 429.27$ and $F(4, 7441) = 17.24$, $ps < .01$, respectively. As shown in Table 4, post-hoc tests measuring the relative effect sizes of mathematics achievement outcome for the five ethnic groups indicated that the mean score for African American students on mathematics achievement outcome ($M = 44.62$, $SD = 8.73$) was lower than the scores for students of the other ethnic groups. On the other hand, the mean value of attitude outcome for African American students ($M = .15$, $SD = 1.00$) was no different than the mean values for Asian/Pacific Islanders ($M = .14$, $SD = .97$), Hispanics ($M = .06$, $SD = .98$), and Native Americans ($M = .11$, $SD = .95$). In addition, the mean attitude outcome value for African Americans was greater than that of Whites ($M = -.07$, $SD = 1.00$).

Insert Table 4 here

The second set of analyses addressed the relationship of the productivity factors to mathematics achievement and attitude outcomes for the different the ethnic groups. To address this issue, the following regression analyses were conducted. The first pair of analyses included the productivity factors, school socio-economic status, and usefulness of mathematics as predictors of mathematics achievement and attitudes, respectively; the second regression analyses included the predictor variables from the first analysis and the ethnic variables with African Americans as the comparison group; the third pair of analyses included the all variables from the

second analysis and the cross products of the ethnic variables with the productivity factors, school socio-economic status, and usefulness of mathematics.

The results of the first regression analyses indicated that the educational productivity factors were related to both mathematics achievement, $\underline{R}^2 = .80$, $\underline{p} < .01$, and attitude outcomes, $\underline{R}^2 = .17$, $\underline{p} < .01$, among the participants. Adding the ethnic variables to the regression equations and using African American students as the comparison group, the results of the second regression analyses indicated that when the differences in the educational productivity factors were held constant, Asian/Pacific Islanders ($\underline{\beta} = .05$, $\underline{p} < .01$), Hispanics ($\underline{\beta} = .03$, $\underline{p} < .01$), and Whites ($\underline{\beta} = .07$, $\underline{p} < .01$) had higher mathematics achievement outcome values than African Americans. There was no difference between African Americans and Native Americans with respect to mathematics achievement outcome ($\underline{\beta} = .02$, ns.).

It is important to note that the differences in the achievement scores between African Americans and the other ethnic groups were substantially reduced when the productivity factors were included in the regression analyses. Based on the results of the post-hoc tests for the analysis of variance and the regression analyses, it can be seen that the difference in the mathematics achievement scores between Asian/Pacific Islanders and African Americans decreased from 11.7 units to 1.6 units when the productivity factors were held constant. Similarly, the difference in scores between Whites and African Americans was reduced from 12.4 units to 1.3 units. The difference in scores between Hispanics and African Americans also decreased from 1.5 units to .7 units upon inclusion of the productivity factors in the regression equation. Thus, the significance of the regression coefficients for ethnicity may be an artifact of the size of the sample.

When attitude outcome was regressed on the predictor variables in this analysis, it was found that African Americans had a higher average value for attitude outcome than Whites (β = -.07, $p < .01$). The average attitude outcome values of the other ethnic groups were no different than that of African Americans (see Table 5).

The third pair of analyses were conducted to determine if the influence of the productivity factors on mathematics achievement and attitudes for African Americans differed from the influence of the factors on these outcomes for the other ethnic groups. The results of these analyses indicated that there was no interaction between mathematics achievement outcome and ethnicity, R^2 - change = .00, ns. It was also found that there was no interaction between attitude outcome and ethnicity, R^2 - change = .01, ns. Thus, the relationship of the educational productivity factors on mathematics achievement and attitudes were no different for African Americans than for the other four ethnic groups. A summary of the results of the regression analyses are illustrated in Table 5.

Insert Table 5 here

As there was no difference in the influence of the Productivity Factors on either mathematics achievement outcome or attitude outcome between African Americans and members of the other ethnic groups, the model is examined with all five ethnic groups combined and only differences in the relative importance of the productivity factors and the other independent variables for the entire sample are described. Tables 6 and 7 summarize the relationship between the independent variables and mathematics achievement and attitude outcome, respectively,

among all five ethnic groups.

Insert Tables 6 and 7 here

Relationship Between Independent Variables and Outcome Variables

Mathematics Achievement Outcome. The results of the current multiple regression analyses revealed that, when ethnic differences were held constant, ten of the fourteen predictor variables were associated with mathematics achievement outcome among the participants. Among these variables, nine of these represented the educational productivity factors. In order of significance, these variables were: prior mathematics achievement, quantity of instruction, self concept, quality of instruction, parental aspirations, expectancy of success, peer influences, family income, and amount of reading done outside of school. Additionally, school socioeconomic status was found to be related to mathematics achievement outcome. Among the independent variables associated with mathematics achievement outcome, peer influences was found to be the only variable that was negatively related to this outcome.

Mathematics Attitude Outcome. Multiple linear regression analysis showed that four independent variables were related to mathematics attitude outcome among the participants in the current study. In particular, self concept and student's perceived usefulness of mathematics in the future were positively related to attitude outcome. Conversely, school socioeconomic status and amount of reading outside of school were negatively related to attitude outcome.

It should also be noted that the use of listwise regression procedures lead to a reduction of the original sample size, as only those students who responded to all of the items were included

the current analyses.

Discussion

General Research Findings

The results of the analyses of this study indicated that the influence of the productivity factors on mathematics achievement and attitude outcomes are no different for African Americans than for the other ethnic groups. The findings of the present study imply that differences in the levels of factors which influence achievement, rather than ethnicity, per se, had a substantial influence on the achievement outcomes of the participants. Similar results were found regarding attitudes toward mathematics among different ethnic groups. Previous research has discovered that factors which exist prior to secondary school have an influence on subsequent mathematics achievement, particularly for under-represented minorities (Peng and others, 1995). The results of the present study lend further support to the hypothesis that optimization of the productivity factors, early in the academic career of the student, has a significant impact on subsequent achievement in mathematics. Additional findings of the current study are discussed below.

The results of the ANOVA and follow-up tests indicated that the average mathematics achievement outcome of African Americans was lower than the average achievement of Asian/Pacific Islanders, Hispanics, and Whites before differences in the productivity factors were controlled. It has been well documented that Whites and Asian/Pacific Islanders perform better on tests of mathematics achievement than African Americans, as well as other under-represented ethnic and language minority students (Cheek, 1984; Jones, 1984; Peng and others, 1995; Valverde, 1984), and these differences have been found to be quite large (Gross, 1993; Jones, 1984). Large-scale national research studies have determined that Hispanics also tend to out-

perform African Americans on tests of mathematics achievement (National Assessment of Educational Progress, 1980, 1981, 1982, 1983). The current research suggests that differences in mathematics achievement across ethnic groups may be attributed to differences in the levels of the educational productivity factors between the groups.

The findings of the current investigation also indicated that the productivity factors were strongly associated with mathematics achievement outcome. In particular, it was determined that over 80 percent of the variance in mathematics achievement outcome can be accounted for by the productivity factors. It should be noted that this percentage could, in fact, be an underestimate of the actual measure of the relationship of the productivity factors to achievement because many items measuring one or more of the factors may not have been included in the analyses (see Limitations). Nonetheless, this finding is in agreement with previous research which has determined that the productivity factors are consistently related to mathematics achievement outcomes (Fraser and others, 1987; Ibe, 1994; Peng and others, 1995).

The current research indicated that when the educational productivity factors were held constant for all of the ethnic groups included in the present study, African Americans, on average, had lower mathematics achievement than Asian/Pacific Islanders, Hispanics, and Whites. However, it should be noted that the magnitude of these differences were extremely small and appeared to be an artifact of the large sample size. Moreover, the combined results of the ANOVA and second set of regression analyses indicated that there were substantial decreases in the differences in the achievement scores between African American students and students from other ethnic groups once the differences in the productivity factors were controlled.

It was found that African Americans had more positive attitudes towards mathematics

than Whites. There were no differences, however, in the attitudes of African Americans and either Asian/Pacific Islanders, Hispanics, or Native Americans. Other studies have indicated similar results regarding differences in attitudes between minority and majority students (e.g., Hilton and Lee, 1988; Peng and others, 1995).

The productivity factors were found to be related to mathematics attitude outcomes. However, it should be emphasized that the magnitude of the impact of the productivity factors on attitude did not appear nearly as large as their impact on mathematics achievement. In particular, only 17 percent of the variance in mathematics attitude outcome can be attributed to the educational productivity factors. There are some possible reasons for the apparent disparity between the relationship of the productivity factors with mathematics achievement and attitude towards mathematics, respectively. One explanation may be that some variables, which have been found to be related to attitude were not included in the present analyses. Some research has indicated that teaching practices and curricular methods such as collaborative learning, individualized instruction, and computer assisted instruction are related to attitude toward mathematics, as well as achievement in mathematics (Anderman, 1993; Campbell and Langrall, 1993; Walberg, 1984). Other research has suggested that the use of cultural referents (i.e., culture of the school or community) in mathematics class may increase class morale and thus, increase student interest in mathematics (Bradley, 1984; Hampton and Gallegos, 1994; Valverde, 1984). It is possible that the inclusion of these factors may have augmented the proportion of variance in attitude outcome accounted for by the variables included in the present research. A second possible explanation for the difference in the impact of the productivity factors between mathematics achievement and attitude is that the relationships of the factors with attitude towards

mathematics are more indirect than direct. This explanation suggests that direct influences of the productivity factors on attitude may be confounded by other variables in the present analyses.

The current research revealed that once the educational productivity factors were held constant for the different ethnic groups, there were still differences in attitude according to ethnicity, in particular, between African Americans and Whites.

However, the findings of the current research seem to show that among African Americans, interest in mathematics has little do with mathematics achievement. Indeed, the results of this study suggests that even though African Americans had more positive attitudes than White students, their mathematics achievement was lower than three of the four other ethnic groups. Research studies have found that for African American students in the elementary grades, attitudinal variables contributed very little towards explaining variation in performance on standardized tests of mathematics achievement (Gross, 1990). The findings of the current study suggest, further, that African American students' attitudes have little do with achievement outcomes, as they progress from elementary school through secondary grades.

Limitations

There were some limitations to the present study that warrant attention. First, this study was based upon survey data, most of which was self-reported. While the findings of this study indicated that many home environmental and school characteristics, as well as instructional processes, were associated with mathematics achievement and/or attitudes, these variables cannot be regarded as causes of differential outcomes, even though the findings are based on rigorous statistical modeling. Many of the items used to represent the educational productivity factors in the current study were based upon students' attitudes and opinions about peers' and/or teachers'

perceptions and classroom practices. Thus, the level of content validity for certain variables in the study, as a function of their indicators, may be of some concern.

Secondly, because the study involved secondary data, there was an implied lack of control over the design of the data set used for the analyses in the current study. For this reason, a complete examination of the relationship between many Productivity Factors and the outcome variables may be limited.

Another limitation of the present study was that it could have been biased against those students who, for one reason or another, did not respond to certain items from the questionnaires. It is possible that some of these students were from more socioeconomically disadvantaged environments than other students in the study. Consequently, the relationships derived from the analyses may be construed as a conservative estimate of the correlation of the productivity factors with mathematics achievement and/or attitude outcomes. In particular, the loss of some students between the base-year study and the second follow-up may have underestimated the actual variability of the sample with respect to the educational productivity factors, as well as mathematics achievement and attitude outcomes.

Finally, the outcome variables, mathematics achievement and attitude outcomes, were measured according to indicators which were obtained at two different times during the primary study. As all of the indicators of the educational productivity factors were derived from the base-year and second follow-up of the initial study, there was a hiatus of two years between measurement of the independent factors and attitude outcome. Thus, during the two years between the first follow-up and the second follow-up, the relationship of the productivity factors with attitudes may have changed.

Suggestions for Future Research

The results of the current study showed that Walberg's educational productivity factors influence achievement and attitude outcomes in mathematics similarly among students of different ethnic backgrounds. The findings also indicated that school socioeconomic status, and to a lesser extent, perceived usefulness of mathematics in the future, were related to mathematics achievement and attitude outcomes. Thus, one of the goals of future research should be to look at the relationship of multiple variables on learning outcomes instead of focussing on single correlates to these outcomes.

Furthermore, the findings showed that some variables exerted more impact on mathematics achievement and attitudes than others and some variables appeared to have indirect influence on the outcome measures, particularly, attitudes toward mathematics. Future research analyses might be designed to investigate the possible interrelationships between the variables and examine causal relationships among the variables which may elicit specific information about optimizing learning outcomes.

The findings of this study also indicated that even though mathematics achievement outcomes differed between African Americans and other ethnic groups, the inclusion of Walberg's educational productivity factors served to greatly diminish the gap in achievement between the ethnic groups. Thus, one of the issues that needs to be addressed in future research is how can the productivity factors be introduced early enough to reduce disparities in mathematics achievement between different ethnic groups which seem to exist prior eighth grade and increase throughout high school and beyond.

The current research suggests further that examining ethnic groups independently may

provide meaningful information regarding the influence of the productivity factors on achievement and attitude outcomes among different ethnic groups. Thus, future research studies may explore the differential impact of multiple variables on ethnic groups independently.

Notes

1 In accordance with the Publication manual of the American Psychological Association (Fourth Edition), I used the term African American for those participants indicating their race as Black non-Hispanic in racial origin on the demographic portion of the National Education Longitudinal Study of 1988 (NELS:88). The manual indicates that both African American and Black are acceptable terms (p. 52).

The terms White, Hispanic, Native American, and Asian/Pacific Islander are directly derived from the terms used to describe self-reported racial/ethnic background of the participants according to the Student Component of Data File User's Manual of NELS:88, 1989.

References

Anderman, E., and others. (1993). Perceptions of mathematics classroom climate: A multilevel study. Paper presented at the Annual Meeting of the American Psychological Association, Toronto, Ontario, Canada.

Anderson, B. J. (1990). Minorities and mathematics: The new frontier and challenge of the nineties. Journal of Negro Education, 59, 260-271.

Annick, C. M., Carpenter, T.P., & Smith, C. (1981). Minorities and mathematics: Results from the National Assessment of Educational Progress. Mathematics Teacher, 74, 560-566.

Bailey, R. (1990). Mathematics for the millions, science for the people: Comments on Black students and the mathematics, science, and technology pipeline. Journal of Negro Education, 59, 239-245.

Bradley, C. (1984). Issues in mathematics education for Native Americans and directions for research. Journal for Research in Mathematics Education, 15, 96-106.

Campbell, P. F. & Langrall, C. (1993). Making equity a reality in classrooms. Arithmetic Teacher, 41, 110-113.

Cheek, H. N. (1984). Increasing the participation of Native Americans in mathematics. Journal for Research in Mathematics Education, 15, 107-113.

Cross, T. (1995). Vital signs: Statistics that measure the state of racial inequality. The Journal of Blacks in Higher Education, 9, 43-49.

Ferguson, R. F. (1990). Racial patterns in how school and teacher quality affect achievement and earnings (UP 028 202). Cambridge, MA: John F. Kennedy School of Government. (ERIC Document Reproduction Service No. ED 347 217).

Fraser, B. J., Walberg, H. J., Welch, W. W., and Hattie, J. A. (1987). Syntheses of educational productivity research. International Journal of Educational Research, 11, 145-252.

Gross, Susan. (1993). Early mathematics performance and achievement: Results of a study within a large suburban school system. Journal of Negro Education, 62, 269-285.

Hampton, E., & Gallegos, C. (1994). Science for all students. Science Scope, 17, 5-6.

Harnisch, D., & Archer, J. (1986, April). Mathematics productivity and educational influences for secondary students in Japan, India, and the United States. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Hernandez, N.G. (1981). Improved mathematics achievement for Mexican-Americans is possible now. Unpublished manuscript, The University of Texas at El Paso, College of Education.

Hilton, T. & Lee, V. (1988). Student interest and persistence in science. Changes in the educational pipeline in the last decade. Journal of Higher Education, 59, 510-525.

Ibe, R.E. (1994, April). The enduring affects of productivity factors on eighth grade students'mathematical outcome. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Jones, L.V. (1985). White-Black achievement differences: the narrowing gap. American Psychologist, 39, 1207-1213.

Lee, C. D. & Slaughter-Defoe, D. T. (1995). Historical and sociocultural influences on African American education. In J. A. Banks (Ed.), Handbook of Research on Multicultural Education (pp. 348-371). New York: Macmillan.

National Assessment of Educational Progress. (1983). The third national mathematics assessment: Results, trends, and issues. Denver, CO: Education Commission of the States.

National Center for Education Statistics. (1993). National Educational Longitudinal Study of 1988. Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Peng, S., and others. (1995). Understanding racial-ethnic differences in secondary school science and mathematics achievement: Research and development report (Doc. No. SE 055 976). Washington, DC: National Center for Education Statistics. (ERIC Document Reproduction Service No. ED 381 342).

Peng, S., Fetters, W.B., Kolstad, A.J. (1981). High school and beyond: A national longitudinal study for the 1980's: A capsule description of high school students. Washington, DC: U.S. Department of Educational Research and Improvement, National Center for Education Statistics.

Peng, S., Wright, D. (1994). Explanation of academic achievement of Asian American students. Journal of Educational Research, 87, 346-352.

Reyes, L. H., & Stanic, G.M.A. (1985). A review of the literature on Blacks and mathematics (Doc. No. SE 045 579). Washington, DC: National Institute of Education. (ERIC Document Reproduction Service No. ED 260 945).

Valverde, L.A. (1984). Underachievement and underrepresentation of Hispanics in mathematics and mathematics-related careers. Journal for Research in Mathematics Education, 15, 123-133.

Walberg, H.J. (1984). Improving the productivity of America's schools. Educational Leadership, May, 19-27.

Table 1

Variables in the Model with Coding Scheme and Frequencies for Indicators

Variable	Coding Scheme and Frequencies for Indicators
Race/Ethnicity	Which best describes you? 0000 = White, non-Hispanic (40.2) 0010 = Black, non-Hispanic (18.8) 0100 = Hispanic (23.2) 1000 = Asian/Pacific Islander (11.1) 0001 = American Indian (6.6)
Prior Achievement	Standardized score from cognitive test: base-year Range of scores: Low = 33.9 High = 77.2
Motivation	
Expectancy for Success	"As things stand now, how far in school do you think you will get?" 1 = won't finish high school (1.5) 2 = will finish high school (9.9) 3 = vocational, trade, or business school after high school (8.9) 4 = will attend college (13.7) 5 = will finish college (40.3) 6 = higher schooling after college (25.6)
Self Concept	Respondent has always done well in math. 0 = false (13.0) 1 = mostly false (6.6) 2 = more false than true (13.9) 3 = more true than false (20.5) 4 = mostly true (20.6) 5 = true (25.6) Math one of respondents' best subjects. 0 = false (16.8) 1 = mostly false (7.0) 2 = more false than true (14.9) 3 = more true than false (17.9) 4 = mostly true (15.7) 5 = true (27.6)
Quantity of Instruction	How much course work in the following subjects?: Geometry 0 = none, ½ year (53.3) 1 = 1, 1.5, 2 years (46.7) Algebra II 0 = none, ½ year (76.3) 1 = 1, 1.5, 2 years (23.7)
Quality of Instruction	Often review math work from previous day? 0 = never (7.4) 1 = sometimes (34.9) 2 = often (57.7) In math class, how much emphasis does your teacher place on thinking about what a problem means and ways it might be solved? 0 = none (5.1) 1 = minor (11.9) 2 = moderate (30.0) 3 = major (52.9)

BEST COPY AVAILABLE

Table 1 (continued)

Variables in the Model with Coding Scheme and Frequencies for Indicators

Variable	Coding Scheme and Frequencies for Indicators
School SES	Students in Free or Reduced Cost Lunch Program in School.
	7 = None (15.5)
	6 = 1 - 5% (13.7)
	5 = 6 - 10% (10.6)
	4 = 11 - 20% (16.9)
	3 = 21 - 30% (14.0)
	2 = 31 - 50% (16.1)
	1 = 51 - 75% (9.2)
	0 = 76 - 100% (4.0)
Home Environment	
Parental Education	How far in school did your father go?
	7 = Ph.D., M.D. (6.9)
	6 = master's degree (8.4)
	5 = graduated college (14.8)
	4 = less than 4 years of college (8.0)
	3 = junior college (10.7)
	2 = graduated high school (30.5)
	1 = did not finish high school (20.6)
	How far in school did your mother go?
	7 = Ph.D., M.D. (3.0)
	6 = master's degree (7.7)
	5 = graduated college (14.0)
	4 = less than 4 years of college (8.7)
	3 = junior college (11.5)
	2 = graduated high school (34.0)
	1 = did not finish high school (21.1)
Family Income	Yearly Family Income
	15 = $200,000 or more (1.7)
	14 = $100,000 - $199,999 (4.3)
	13 = $75,000 - $99,999 (4.3)
	12 = $50,000 - $74,999 (14.3)
	11 = $35,000 - $49,000 (20.3)
	10 = $25,000 - $34,999 (18.2)
	9 = $20,000 - $24,999 (9.8)
	8 = $15,000 - $19,999 (7.5)
	7 = $10,000 - $14,999 (7.9)
	6 = $7,500 - $9,999 (3.7)
	5 = $5,000 - $7,499 (3.2)
	4 = $3,000 - $4,999 (1.9)
	3 = $1,000 - $2,999 (1.5)
	2 = Less Than $1,000 (0.9)
	1 = None (0.4)
Parental Aspirations	How far in school father wants respondent to go?
	0 = don't know or parent doesn't care (10.1)
	1 = less than high school graduation (0.8)
	2 = graduation from high school (4.3)
	3 = vocational school after high school (6.2)
	4 = attend 2-year college (4.5)
	5 = attend 4-year college (9.1)
	6 = graduation from college (42.8)
	7 = post-graduate education (22.1)

BEST COPY AVAILABLE

Table 1 (continued)

Variables in the Model with Coding Scheme and Frequencies for Indicators

Variable	Coding Scheme and Frequencies for Indicators
	How far in school mother wants respondent to go? 0 = don't know or parent doesn't care (7.4) 1 = less than high school graduation (0.9) 2 = graduation from high school (4.2) 3 = vocational school after high school (6.5) 4 = attend 2-year college (5.0) 5 = attend 4-year college (9.6) 6 = graduation from college (43.4) 7 = post-graduate education (23.1)
Classroom Environment	I am often afraid to ask questions in mathematics class. 0 = strongly disagree (12.5) 1 = disagree (30.3) 2 = agree (42.2) 3 = strongly agree (15.0)
Peer Influences	Among friends, how important to study? 0 = not important (8.2) 1 = somewhat important (52.8) 2 = very important (39.0)
	Among friends, how important to get good grades? 0 (5.5) 1 (42.0) 2 (52.6)
	Among friends, how important to continue their education past high school? 0 (7.7) 1 (36.6) 2 (55.6)
Use of out-of-school time	
Television Viewing Time	During the school year, how many hours a day do you usually watch TV on weekdays? 0 = don't watch TV (3.8) 1 = less than 1 hour a day (8.5) 2 = 1 - 2 hours (21.5) 3 = 2 - 3 hours (22.2) 4 = 3 - 4 hours (17.3) 5 = 4 - 5 hours (11.8) 6 = over 5 hour a day (14.9)
	During the school year, how many hours a day do you usually watch TV on weekends? 0 (4.1) 1 (5.8) 2 (12.1) 3 (16.7) 4 (17.1) 5 (15.7) 6 (28.5)
Reading Done Outside of School	How much reading done on own outside of school each week? 0 = none (17.8) 1 = 1 hour or less (33.1) 2 = 2 hours (20.0) 3 = 3 hours (11.2) 4 = 4 - 5 hours (9.2) 5 = 6 -7 hours (3.7) 6 = 8 - 9 hours (1.6) 7 = 10 hours or more (3.3)

Table 1 (continued)

Variables in the Model with Coding Scheme and Frequencies for Indicators

Variable	Coding Scheme and Frequencies for Indicators
Usefulness of Mathematics	Math will be useful in my future. 0 = strongly disagree (3.4) 1 = disagree (7.9) 2 = agree (41.6) 3 = strongly agree (47.1)
Achievement Outcome	Standardized score from cognitive test: first follow-up Range of score: Low = 31.43 High = 71.93
Attitude Outcome	Describe the reasons for taking or not taking a mathematics class this term: I am interested in mathematics. 0 = not important (13.2) 1 = 1 (11.2) 2 = some importance (27.7) 3 = 3 (17.9) 4 = very important (30.3) I am not interested in mathematics. 0 = yes (40.6) 1 = no (59.4)

Note. Frequencies for each response are given in parentheses.

Table 2

Descriptive Information for Outcome Variables Among Five Ethnic Groups

Variable	Indicator	Ethnicity	N	M	SD	Min	Max
Math achievement outcome	Mathematics Standardized Score from First Follow-up	African American	1583	44.62	8.73	31.67	71.93
		White	3651	52.97	9.85	33.88	71.93
		Asian/Pacific Islander	959	56.31	10.06	32.47	71.93
		Hispanic	1935	46.16	8.81	32.02	71.05
		Native American	584	46.68	8.74	31.47	68.23
Math attitude outcome	Interest in mathematics for students taking math during Second Follow-up	African American	809	2.57	1.40	0	4
		White	1860	2.32	1.36	0	4
		Asian/Pacific Islander	654	2.63	1.32	0	4
		Hispanic	883	2.51	1.31	0	4
		Native American	207	2.51	1.28	0	4
	Interest in mathematics for students not taking math during Second Follow-up	African American	511	.68	.46	0	1
		White	1289	.55	.50	0	1
		Asian/Pacific Islander	271	.64	.48	0	1
		Hispanic	728	.62	.49	0	1
		Native American	247	.66	.47	0	1

Table 3

Bivariate Correlations Between Independent and Dependent Variables

Independent Variable	Correlation with Mathematics Achievement	Correlation with Attitude Toward Mathematics a	Correlation with Attitude Toward Mathematics b	Mean	Standard Deviation
Quantity of Instruction	.58**	.17**	-.01	.69	.74
Usefulness of Math	.10**	.15**	.08**	2.32	.76
Home: Parents Education	.42**	-.01	-.09**	3.45	1.89
Home: Parents Aspirations	.34**	.06**	-.02	5.34	1.89
Home: Family Income	.42**	-.04**	-.09	9.74	2.66
Classroom Environment	.17**	.08**	.04*	1.98	.79
Quality of Instruction	.21**	.09**	.04*	3.81	1.21
School SES	.36**	-.03**	-.09**	3.94	2.07
Peers	.07**	.11**	.03	4.26	1.55
Motivation: Expectancy for Success	.42**	.05**	-.03	4.58	1.31
Motivation: Self-Concept	.34**	.45**	.28**	5.99	3.24
Television Viewing Time	-.14**	-.03*	.03	7.39	2.96
Reading Done Outside of School	.17**	-.04**	-.03*	2.01	1.77
Prior Math Achievement	.89**	.13**	-.02	49.83	10.30

[a] This variable represents Attitude Outcome among students enrolled in a mathematics course during the second follow-up of NELS:88.
[b] This variable represents Attitude Outcome among students not enrolled in mathematics course during the second follow-up of NELS:88.
*$p < .05$. **$p < .01$.

Table 4

Mean Differences for Outcome Variables Among Ethnic Groups

Variable	M	Ethnicity	Mean Difference (d)[1]				
Mathematics Achievement Outcome	56.31	Asian/Pacific Islander	--				
	46.16	Hispanic	10.15*	--			
	44.62	African American	11.70*	1.54*	--		
	56.97	White	.66	10.81*	12.35*	--	
	46.68	Native American	9.64*	.51	2.06*	10.26*	
Mathematics Attitude Outcome	.14	Asian/Pacific Islander	--				
	.06	Hispanic	.08	--			
	.15	African American	.00	.09	--		
	-.07	White	.22*	.13*	.22*	--	
	.11	Native American	.03	.05	.03	.19*	--

[1] Effect sizes, "d", is the standardized mean-difference.
* $p < .01$.

Table 5

Results of Regression Analyses

Purpose for Regression Analysis	Variables in the Analysis	Criteria for Testing Significance of Test
Are the Productivity Factors Related to Mathematics Achievement Outcome?	Independent Variables: Productivity Factors, School SES, and Usefulness of Mathematics Dependent Variable: Mathematics Achievement Outcome	$R^2 = .80^*$
Are the Productivity Factors Related to Attitude Outcome?	Independent Variables: Productivity Factors, School SES, and Usefulness of Mathematics Dependent Variable: Attitude Outcome	$R^2 = .17^*$
Once the Productivity Factors are controlled, are there differences in Mathematics Achievement between African Americans and other ethnic groups?	Independent Variables: Productivity Factors, School SES, Usefulness of Mathematics, and Ethnic Categories for non-African Americans Dependent Variable: Mathematics Achievement Outcome	Asian/Pacific Islanders: $\beta = .05^*$ Hispanics: $\beta = .03^*$ Whites: $\beta = .07^*$ Native Americans: $\beta = .02$
Once the Productivity Factors are controlled, are there differences in Attitude between African Americans and other ethnic groups?	Independent Variables: Productivity Factors, School SES, Usefulness of Mathematics, and Ethnic Categories for non-African Americans Dependent Variables: Attitude Outcome	Asian/Pacific Islanders: $\beta = -.03$ Hispanics: $\beta = -.03$ Whites: $\beta = -.07^*$ Native Americans: $\beta = .00$
Are the influences of the Productivity Factors on Mathematics Achievement the same for African Americans and other ethnic groups?	Independent Variables: Productivity Factors, School SES, Usefulness of Mathematics, Ethnic Categories for non-African Americans, and Products of Ethnic Categories other Independent Variables Dependent Variable: Mathematics Achievement Outcome	R^2-change = .00
Are the influences of the Productivity Factors on Attitude the same for African Americans and other ethnic groups?	Independent Variables: Productivity Factors, School SES, Usefulness of Mathematics, Ethnic Categories for non-African Americans, and Products of Ethnic Categories other Independent Variables Dependent Variable: Attitude Outcome	R^2-change = .01

* $p < .01$

Table 6

Summary of Multiple Linear Regression Analysis for Independent Variables Related to Mathematics Achievement Outcome (N = 4602)

Variable	B	SE B	β
Prior Mathematics Achievement	.68	.01	.71*
Quantity of Instruction	1.51	.11	.11*
Quality of Instruction	.37	.06	.04*
School Socioeconomic Status	.14	.04	.03*
Classroom Environment	.19	.09	.01
Peer Influences	-.17	.04	-.03*
Usefulness of Mathematics	.10	.09	.01
Self Concept	.22	.02	.07*
Expectancy of Success	.33	.07	.04*
Parental Expectations	.25	.04	.04*
Parental Education	.07	.04	.01
Family Income	.11	.03	.03*
Reading Done Outside of School	.10	.04	.02*
Television Viewing Time	.03	.02	.01

$R^2 = .81$.

* $p < .01$.

Table 7

Summary of Multiple Linear Regression Analysis for Independent Variables Related to Mathematics Attitude Outcome (N = 3949)

Variable	B	SE B	ß
Prior Mathematics Achievement	.00	.00	.03
Quantity of Instruction	.06	.02	.04
Quality of Instruction	.01	.01	.01
School Socioeconomic Status	-.02	.01	-.05*
Classroom Environment	.02	.02	.02
Peer Influences	.02	.01	.04
Usefulness of Mathematics	.06	.02	.04*
Self Concept	.12	.01	.37*
Expectancy of Success	-.01	.02	-.02
Parental Expectations	-.01	.01	-.02
Parental Education	-.02	.01	-.04
Family Income	-.02	.01	-.04
Reading Done Outside of School	-.02	.01	-.04*
Television Viewing Time	.00	.01	-.01

$R^2 = .18$.

* $p < .01$.

SE062592

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

ERIC

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Influences on Mathematics Learning Among African American High School Students	
Author(s): John P. Thomas	
Corporate Source:	Publication Date:

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY ____ Sample ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 1	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY ____ Sample ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2A	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY ____ Sample ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2B
Level 1 ☑	Level 2A ☐	Level 2B ☐
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here,→ please

Signature: John P. Thomas	Printed Name/Position/Title: John P. Thomas (Ph.D.)	
Organization/Address: 225 East Lakeside Dr. Vernon Hills, IL 60061	Telephone: (847)816-7950	FAX:
	E-Mail Address: JThomas649@aol.com	Date: 5/13/99

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

THE UNIVERSITY OF MARYLAND
ERIC CLEARINGHOUSE ON ASSESSMENT AND EVALUATION
1129 SHRIVER LAB, CAMPUS DRIVE
COLLEGE PARK, MD 20742-5701
Attn: Acquisitions

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
1100 West Street, 2nd Floor
Laurel, Maryland 20707-3598

Telephone: 301-497-4080
Toll Free: 800-799-3742
FAX: 301-953-0263
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com